temperature of the control, whichever is higher. During the test, the control is to be operated in a manner representing the opening and closing of the door at a rate of one open-close operation per minute.

(b) In the evaluation of entrapment protection circuits used in residential garage door operators, the critical condition flow chart shown in figure 1 shall be used:

(1) To conduct a failure-mode and effect analysis (FMEA);

(2) In investigating the performance during the Environmental Stress Tests; and

(3) During the Power Cycling Tests in accordance with the Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991, 1st ed., dated July 19, 1991. This incorporation by reference was approved by the Director of the Federal Register in accordance with U.S.C. 552(a) and 1 CFR part 51. Copies may be obtained from Underwriters Laboratories, Inc., 333 Pfingsten Road, Northbrook, IL 60062–2096. Copies may be inspected at the Consumer Product Safety Commission, Office of the Secretary, 4330 East West Highway, Bethesda, Maryland or at the Office of the Federal Register, 800 North Capitol Street, NW., suite 700, Washington, DC.

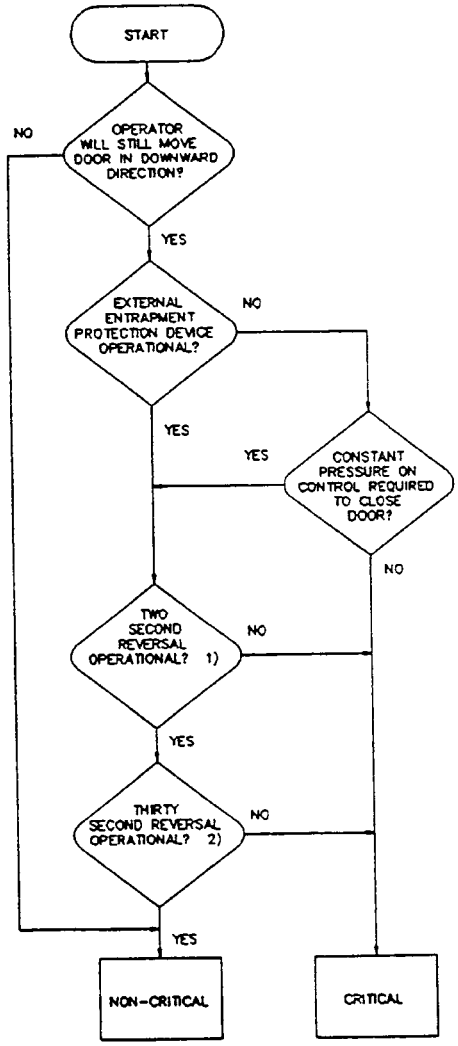
[57 FR 60455, Dec. 21, 1992, as amended at 62 FR 46667, Sept. 4, 1997]

### § 1211.6 General entrapment protection requirements.

(a) A residential garage door operator system shall be provided with inherent entrapment protection that complies with the requirements as specified in § 1211.7.

Figure 1

## CRITICAL CONDITION FLOW CHART ENTRAPMENT PROTECTION DEVICES AND FUNCTIONS




(b) In addition to the inherent entrapment protection as required by paragraph (a) of this section, a residential garage door operator shall comply with one of the following:

(1) Shall be constructed to:

(i) Require constant pressure on a control to lower the door,

(ii) Reverse direction and open the door to the upmost position if constant pressure on a control is removed prior to operator reaching its lower limit, and

(iii) Permit a portable transmitter, if provided, to only function to cause the operator to open the door.

(2) Shall be provided with a means for connection of an external entrapment protection device as described in §§ 1211.8, 1211.10, 1211.11, and 1211.12.

(c) A mechanical switch or a relay used in an entrapment protection circuit shall withstand 100,000 cycles of operation controlling a load no less severe (voltage, current, power factor, inrush, and the like) than it controls in the operator, and shall function normally upon completion of the test.

(d) If failure of a switch or relay (open or short) described in paragraph (c) of this section results in loss of any entrapment protection required by § 1211.7(a), 1211.7(f), or 1211.8(a), the door operator shall result in one of the following conditions:

(1) The door operator becoming inoperative by the end of the open or close operation, or

(2) The door moving to and staying within 1 foot (305 mm) of the uppermost position.

(e) During the closing cycle, the system providing compliance with § 1211.7(a) and 1211.7(f) shall function regardless of a short or open anywhere in the low-voltage external wiring to the control, external entrapment devices, or any other external component.

### § 1211.7 Inherent entrapment protection requirements.

(a) Except for the first 1 foot (305 mm) of travel as measured over the path of the moving door operating member, both with and without any external entrapment protection device functional, a downward moving residential garage door operator shall initiate reversal of the door within 2 seconds of contact with the obstruction as specified in paragraph (b) of this section. After reversing the door, the door operator shall return the door to and stop at the full upmost position, unless a control is actuated or an inherent entrapment circuit senses an obstruction to stop the door during its upward travel. Compliance with this paragraph shall be tested in accordance with paragraphs (b) through (g) of this section.

(b) For the tests described in paragraph (a) of this section, a solid object is to be placed on the floor of the test installation and at various heights under the edge of the door and located in line with the driving point of the operator. When tested on the floor, the object shall be 1 inch (25.4 mm) high. In the test installation, the bottom edge of the door under the driving force of the operator is to be against the floor when the door is fully closed.

(c) An operator is to be tested for compliance with paragraph (a) of this section for 50 open-and-close cycles of operation while the operator is connected to the type of residential garage door with which it is intended to be used or with the doors specified in paragraph (e) of this section. The force adjustment on the operator is to be at the maximum setting or at the setting that represents the most severe operating condition. Any accessories that could have an effect on the intended operation of entrapment protection functions that are intended for use with the operator, are to be attached and the test is to be repeated for one additional cycle.

(d) The operator is to be adjusted (limit and force) according to instructions provided with the operator. The operator is to be tested for 10 additional obstruction cycles using the solid object described in paragraph (b) of this section at these settings.

(e) If an operator is intended to be used with more than one type of door, one sample of the operator is to be tested on a sectional door with a curved track and one sample is to be tested on a one-piece door with jamb hardware and no track. If the Operator is not intended for use on either or both of these types of doors, a one-piece door with track hardware or a one-piece door with pivot hardware, as appropriate, may be used for the tests. See the marking requirements at § 1211.15 of this subpart.

(f) An operator shall initiate reversal of the door and shall return the door to